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**Asynchronous transfer mode exchange system**

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**(56) Related Art**  
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## Asynchronous Transfer Mode Exchange System

### ABSTRACT

An asynchronous (ATM) exchange system comprises a plurality of input buffers (11) each for receiving data cells from an input cell highway to store the data cells for a while, a plurality of output buffers (12) each for storing data cells for a while to transmit the data cells to an output cell highway, an array of ATM switches (13) each for transferring data cells from one of the input buffers (11) to one of the output buffer (12). The amount of data cells stored in each output 10 buffer (12) is monitored by an output buffer monitor (24) and used for controlling the transfer rate of the data cells from each input buffers (11), thereby increasing durability of the ATM exchange system against a burst signal or buffer congestion.

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**COMPLETE SPECIFICATION**

**FOR A STANDARD PATENT**

**ORIGINAL**

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**Invention Title:** Asynchronous Transfer Mode Exchange System

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

# ASYNCHRONOUS TRANSFER MODE EXCHANGE SYSTEM

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## BACKGROUND OF THE INVENTION

### (a) Field of the Invention:

The present invention relates to an asynchronous transfer mode (ATM) exchange system and, more particularly, to an improvement in controlling the transfer rate of the ATM exchange system for avoiding congestion of the output buffer.

### (b) Description of the Related Art:

15 In a conventional ATM exchange system, RNR (Receive Not Ready) or BP (Backpressure) method is generally used, wherein a data traffic control is effected by using ON/OFF control or a time scheduling control for avoiding duplicated transfer of data  
20 cells to a single output cell highway. A first conventional technique for controlling an ATM exchange system is described in JP-A-3(1991)-230641. Figs. 1 shows the first conventional ATM exchange system described in the publication, wherein the ATM  
25 exchange system comprises an input buffer section

100 including a plurality of input buffers 11 (n  
input buffers, although two of them are shown in the  
figure) each receiving input data from an input cell  
highway 16, an output buffer section 200 including  
5 n output buffers 12 each for transmitting data  
through an output cell highway 17, and an ATM  
exchange module 13 or array of ATM switches  
interposed between the input buffer section and  
output buffer section for effecting RNR control.

10 Each input buffer 11 has n input buffer elements  
21 each corresponding to one of the output buffers  
12. Each input buffer element 21 of the input buffer  
11 has a FIFO (first-in-first-out) function for  
transfer of the stored data cells to the  
15 corresponding output buffer 12. The input buffer  
section 100 also comprises a cell output stopper 15  
for each input buffer 11 for stopping cell transfer  
from the input buffer element 21 to an output buffer  
12 which is in congestion, i.e., temporarily stores  
20 large amount of data cells. The output buffer  
section also includes a buffer threshold monitor 14  
for each output buffer 12.

Each buffer threshold monitor 14 functions for  
monitoring the corresponding output buffer 12 as to  
25 whether or not the amount of data cells stored in

the output buffer 12 exceeds a buffer threshold, and feeds a congestion signal or RNR signal to each cell output stopper 15 when the amount of stored data cells in the corresponding output buffer 12 exceeds the threshold. In this configuration, if the ATM exchange system operates in a state where a particular output buffer operates over the buffer threshold, e.g., if a burst traffic is generated in the ATM exchange system in connection with the particular output buffer 12, the input buffer elements 21 associated with the particular output buffer 12 are stopped by RNR signals.

In the first conventional ATM exchange system using the RNR control method, if the amount of cells stored in an output buffer 12 remains in the vicinity of the buffer threshold and yet the amount of the data cells being transferred from the input buffer 11 is substantially equal to the amount of the data cells transmitted from the output buffer 12, the RNR signal suppresses the amount of data cells transferred from the input buffer 11 to the output buffer 12, thereby lowering the throughput of the ATM exchange switch.

It may be considered that a threshold for restarting of data transfer is separately

determined from the threshold for stopping data transfer to have a hysteresis. However, it only results in the increase of the interval of the stopping of the data transfer for the time corresponding to the difference between the thresholds, and remains substantially in a similar situation.

Fig. 2 shows a second conventional ATM exchange system using a time scheduling method. The ATM exchange system comprises a plurality of input buffers 11, a plurality of output buffers 12, and an ATM switch module 13 which are similar to those of the first conventional ATM exchange system. The ATM exchange system of Fig. 22 comprises a timing control section 18 which generates a data transfer stop signal depending on the monitored signal supplied from each input buffer 11, and a cell output control section 19 disposed for each of input buffers 11 for stopping data transfer from the input buffer 11 responsive to the data transfer stop signal.

In the second conventional ATM exchange system, the timing control section 18 must control timing among all inputs of the ATM exchange module 13. Namely, the timing control must be effected at a rate in accordance with the switching rate of the ATM

exchange module 13, which is in fact extremely difficult. This is because the time scheduling operation must be based on the state of each input buffer 11, i.e., amount of the data cells stored in each input buffer 11, and accordingly, a central control must be employed in the timing control section 18 to schedule data transfers from all of the input buffers 11.

#### 10 SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an ATM exchange system for an ATM network, which is capable of controlling data transfer at a rate corresponding to the transfer rate of the output buffers for avoiding a signal congestion in an output buffer.

The present invention provides an asynchronous transfer mode (ATM) exchange system comprising a plurality of input buffers each for receiving data cells from an input cell highway to store the data cells for a while, a plurality of output buffers each for storing data cells for a while to transmit the data cells to an output cell highway, an array of ATM switches each for transferring the data cells from a corresponding one of the input buffers to a



corresponding one of the output buffers, an output buffer monitor circuit for watching the amount of data cells stored in each of the output buffers to generate a cell amount signal representing the amount of data cells stored in the each of the output buffers, and a cell output control circuit for receiving the cell amount signal to control a transfer rate of the data cells transferred from the input buffer based on the cell amount signal.

10 In accordance with the present invention, the transfer rate of each input buffer is controlled by the amount of the data cells stored in the corresponding output buffer. Accordingly, data transfer from the input buffer can follow the actual state of the output buffer, which prevents the congestion of the output buffer resulting from a burst signal.

20 The above and other objects, features and advantages of the present invention will be more apparent from the following description, referring to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

25 Fig. 1 is a block diagram of a first conventional ATM exchange system;

Fig. 2 is a block diagram of a second conventional ATM exchange system;

Fig. 3 is a block diagram of an ATM exchange system according to first and second embodiments of  
5 the present invention; and

Fig. 4 is a schematic block diagram of an ATM exchange system according to a third embodiment of the present invention.

#### 10 DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, the present invention is more specifically described with reference to accompanying drawings, wherein similar constituent elements are designated by the same or similar reference numerals throughout  
15 the drawings.

Referring to Fig. 3, the ATM exchange system according to a first embodiment (and also a second embodiment) of the present invention comprises an input buffer section 100B, output buffer section  
20 200B, and an ATM exchange module 13 or array of ATM switches for data transfer from the input buffer section 100B to the output buffer section 200B. The input buffer section 100B has a plurality of (n) input buffers 11 each corresponding to one of input  
25 cell highways 16, and a plurality of (n) cell output

controllers 23 each corresponding to one of the input buffers 11.

The output buffer section 200B comprises a plurality of (n) output buffers 12 each  
5 corresponding to one of output cell highways 17, and a plurality of output buffer monitors 24 each corresponding to one of the output buffers 12. Each input buffer 11 has n input buffer elements 21 each corresponding to one of the output buffers 12, and  
10 a traffic shaper or traffic shaping circuit 25 disposed for each of the input buffers 11 for shaping data cells stored in the input buffer 11. Each output buffer 12 has n output buffer elements 22 each corresponding to one of the input buffers 11. The  
15 ATM exchange module 13 includes  $n \times n$  ATM switches each corresponding one of input buffer elements 21 or one of output buffer elements 22.

Each input buffer 11 stores for a while data cells supplied from the corresponding input cell highway  
20 16 in one of the input buffer elements 21 corresponding to one of the output buffers 12 specified by the data transfer. Each output buffer 12 stores for a while data cells supplied from the corresponding input buffer elements 21 and delivers  
25 the stored data cells to the corresponding output

cell highway 17 at the transfer rate of the output cell highway.

In the first embodiment of the present invention, each output buffer monitor 24 watches the amount of data cells stored in each output buffer element 22 of the corresponding output buffer 12 to generate a cell amount signal representing a combination of the specified output buffer element 22 and the amount of data cells stored therein. Each cell output controller 23 receives the cell amount signal from the output buffer monitor 24 to control the transfer rate of the data cells, to be transferred from the corresponding input buffer element 21 specified by the cell amount signal, in accordance with the amount represented by the cell amount signal. By this configuration, each input buffer element 21 can be controlled in its transfer rate in accordance with the amount of data cells stored in the corresponding output buffer element 22, thereby increasing durability against a burst signal or buffer congestion occurring sometimes in the system. Specifically, the transfer rate of the input buffer element 21 may be controlled in inverse proportion to the amount of data cells stored in the output buffer element 22 or may be controlled by other

suitable relationship.

In a second embodiment of the present invention, which is also shown in Fig. 3, each output buffer monitor 24 watches the amount of data cells stored in the output buffer 12 as a whole and differentiates the same to obtain the state of increase or decrease of data cells stored in each output buffer 12, to thereby generate an UP/DOWN signal corresponding to the increase/decrease of the amount of data cells stored in the each output buffer 12. Each cell output controller 23 in the input buffer section 100B receives the UP/DOWN signal to control the transfer rate of the corresponding input buffer element 21 so that the transfer rate is increased by one step if the UP/DOWN signal represents a decrease of the amount of data cells stored in the output buffer 12 and is decreased by one step if the UP/DOWN signal represents an increase of the amount of data cells stored in the output buffer 12.

Referring to Fig. 4 showing a third embodiment of the present invention, the ATM exchange system has a configuration similar to that of the ATM exchange system according to the first embodiment shown in Fig. 3 except that the output buffer monitor 24 supplies the cell amount signal representing the

amount of data cells stored in the output buffer 12 to the traffic shaper 25 provided on the output of each input buffer element 21, to thereby control the transfer rate of the input buffer element 21 based  
5 on the mount of data cells stored in the output buffer 12. By this configuration, the transfer rate of each input buffer element 21 is controlled in accordance with the amount of data cells stored in the corresponding output buffer 12, similarly to the  
10 second embodiment.

Since the above embodiments are described only for examples, the present invention is not limited to the above embodiments and various modifications or alterations can be easily made therefrom by those  
15 skilled in the art without departing from the scope of the present invention.

The claims defining the invention are as follows:

~~WHAT IS CLAIMED IS:~~

1. An asynchronous transfer mode (ATM) exchange system comprising a plurality of input buffers each for receiving data cells from an input cell highway to store the data cells for a while, a  
5 plurality of output buffers each for storing data cells for a while to transmit the data cells to an output cell highway, an array of ATM switches each for transferring the data cells from a corresponding one of said input buffers  
10 to a corresponding one of said output buffers, an output buffer monitor circuit for watching the amount of data cells stored in each of said output buffers to generate a cell amount signal representing the amount of data cells stored in  
15 the each of said output buffers, and a cell output control circuit for receiving said cell amount signal to control a transfer rate of the data cells transferred from said input buffer based on said cell amount signal.
2. An ATM exchange system as defined in claim 1 wherein each of said input buffers comprises an input buffer element for each of said output

buffers.

3. An ATM exchange system as defined in claim 2 wherein said cell output control circuit controls the transfer rate of each said input buffer element in accordance with the amount of data cells stored in a corresponding one of said output buffers.
4. An ATM exchange system as defined in claim 3 wherein said cell output control circuit comprises a traffic shaping circuit for controlling the transfer rate of each said input buffer element.
5. An ATM exchange system as defined in claim 2 wherein said cell output control circuit increases and decreases the transfer rate of each said input buffer element in accordance with a decrease or increase of the amount of data cells stored in a corresponding one of said output buffers.
6. An ATM exchange system as defined in claim 2 wherein each of said output buffers comprises



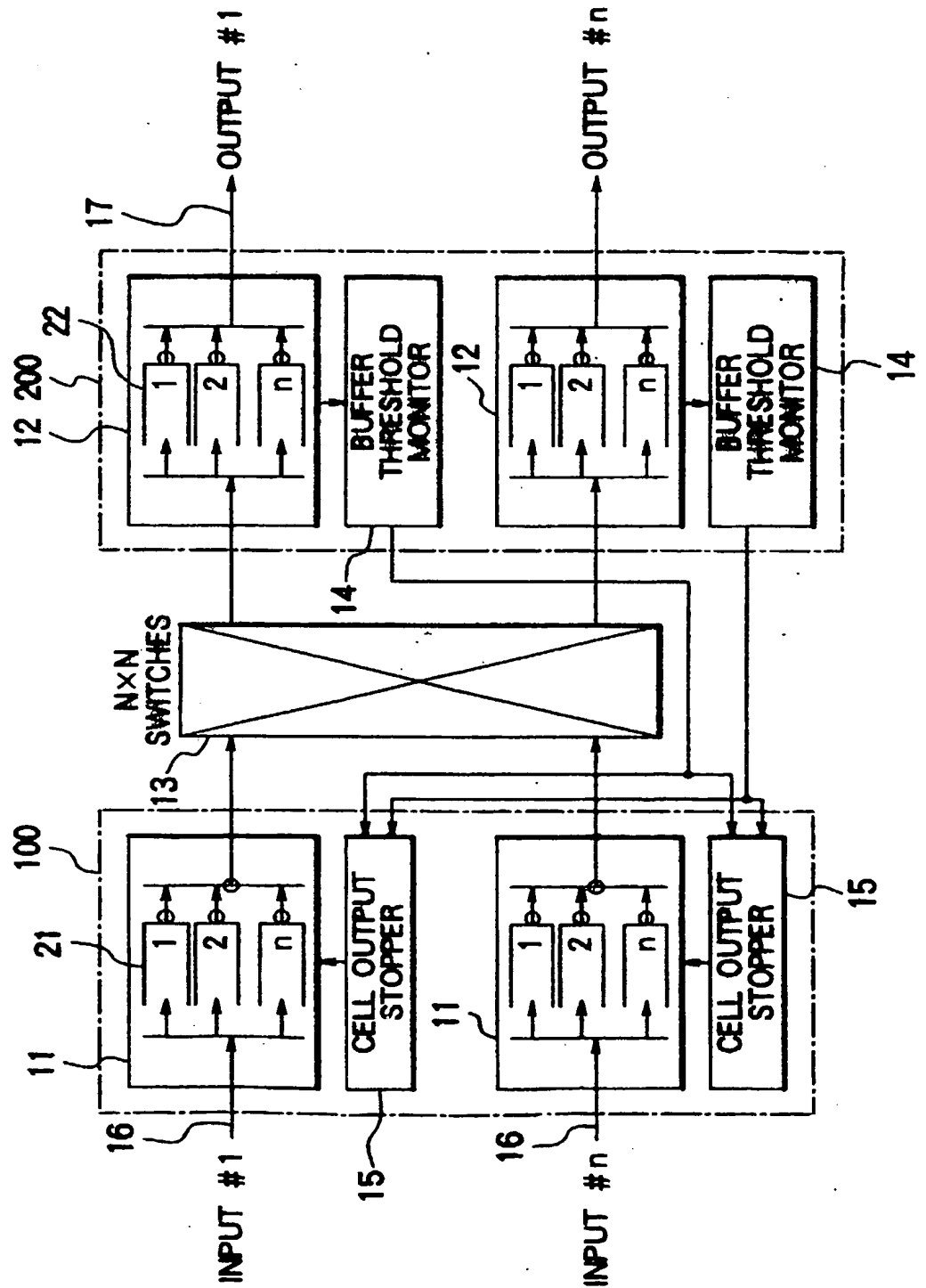
an output buffer element for each of said input buffers.

7. An ATM exchange system as defined in claim 6 wherein said output buffer monitor circuit comprises a output buffer monitor for each of said output buffers.
8. An ATM exchange system as defined in claim 7 wherein said output buffer monitor generates said cell amount signal for each of said output buffer elements.
9. An ATM exchange system substantially as described herein with reference to Fig. 3 or Fig. 4 of the accompanying drawings.

DATED this SEVENTEENTH day of JULY 1997  
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**FIG. 1**  
**PRIOR ART**



**FIG. 2**  
PRIOR ART

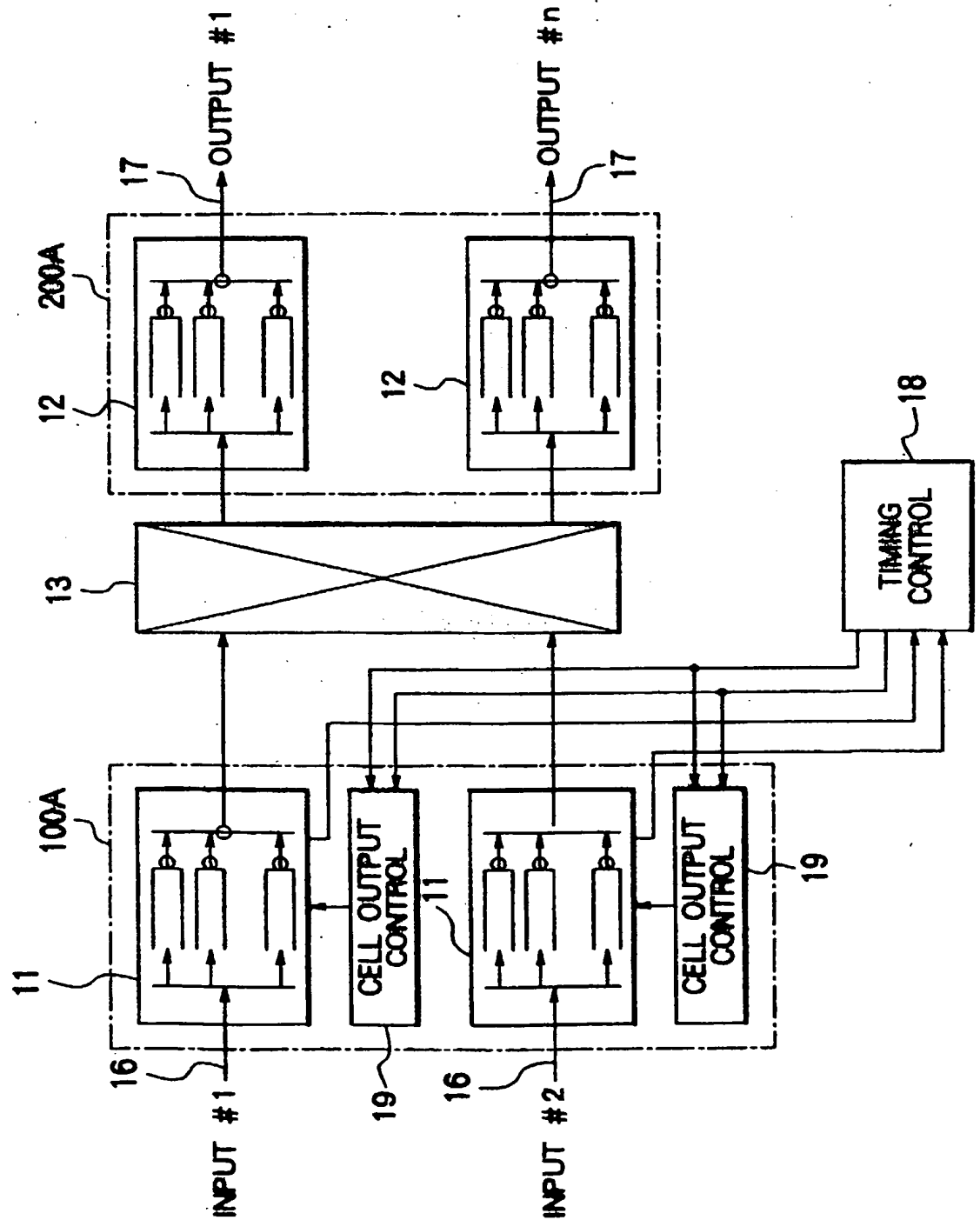


FIG. 3

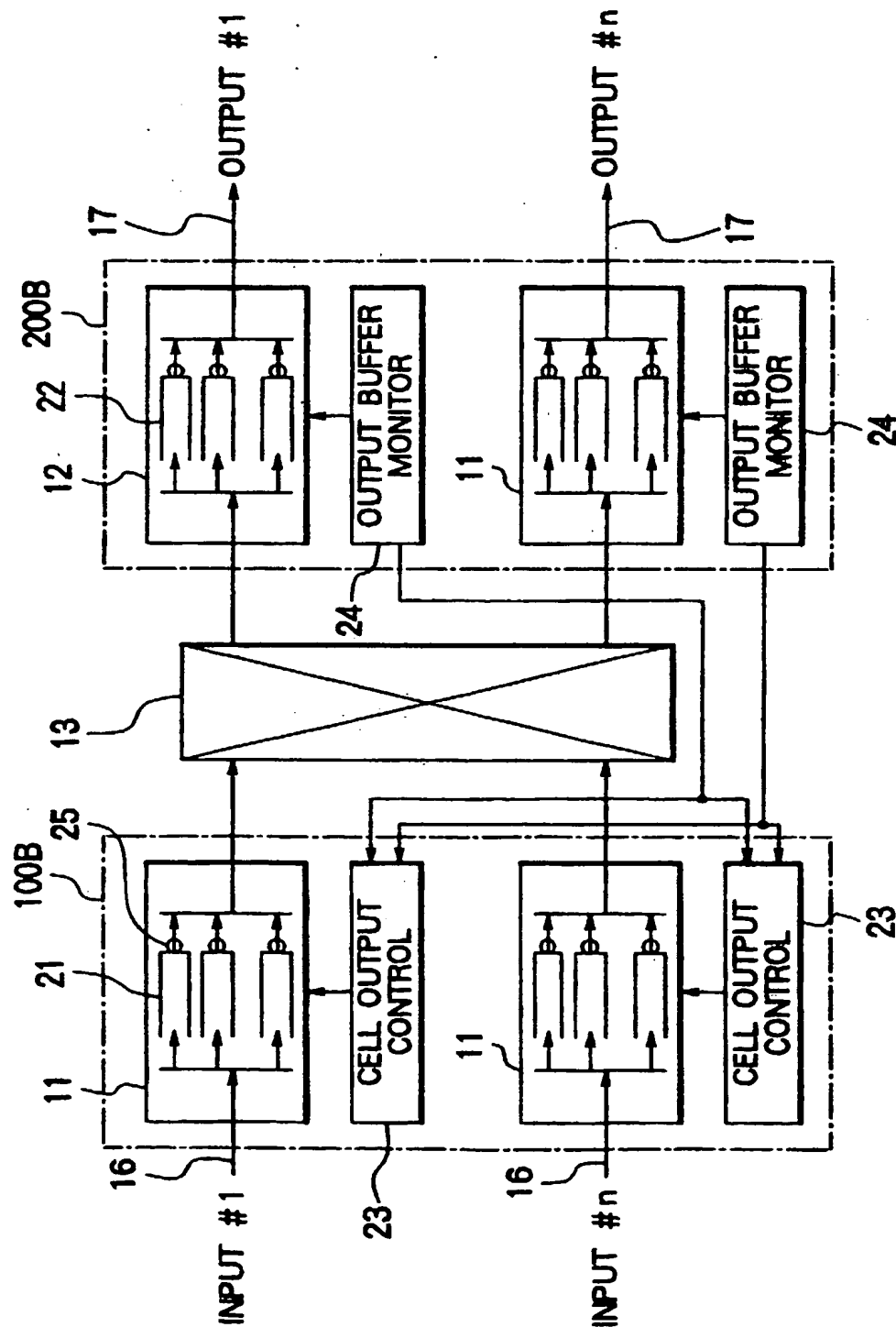


FIG. 4

